

REMARKS

This is a full and timely response to the outstanding non-final Office Action mailed April 4, 2002. Reconsideration and allowance of the application and presently pending claims are respectfully requested.

A. Claim Rejections - 35 U.S.C. § 112

1. Rejections under 35 U.S.C. § 112, First Paragraph

a) Statement of the Rejection

Claims 1-16 and 18 have been rejected for containing subject matter that, it is alleged, was not described in such a way as to enable one skilled in the art to make or use the claimed invention. In particular, the Office Action states that it is unclear how a “non-concave reflector particular with convex outer surface is capable of focusing light.” Seeing as both the reflective and focusing qualities of the non-concave reflector are revealed in the application, Applicant respectfully traverses this rejection.

b) Discussion of the Rejection

The convex reflector 502 disclosed in Figure 5 of the application is an example of a non-concave reflector. The convex reflector comprises a reflector with one surface configured to focus light in the fashion of a lens. Figure 4 explains *how* such focusing is achieved (and was included in the application for this express purpose). In particular, Figure 4 shows how the placement of a plano-convex lens 408 adjacent a reflective surfaces results in light being focused in similar manner to a prior art concave, semispherical mirror 302 shown in Figure 3. The focusing ability of such a lens is commonly known in the art.

Figure 5 illustrates a first optical cavity 500 of the invention, wherein the embodiment modifies the concept introduced in Figure 4, i.e., focusing of light with a plano-convex element.

The reflective planar layers 506 are combined in that embodiment with a convex outer layer 514 to form a first reflector 502 that has a non-concave outer surface 516. As described in the specification, “the convex, semispherical shape of the surface 516 provides a focusing effect similar to the lens 408 shown in FIG. 4 and to that of the concave, semispherical mirror 302 shown in FIG. 3.” Applicant’s specification, page 8, lines 19-21.

Following the path of light through the optical cavity further illustrates the focusing effect of the first reflector 502. Light traveling from the direction of the second reflector 504 into the first reflector 502 will encounter “a reflection delay that is radially symmetric from the center of the reflector ... [which] creates a focusing effect.” Id. at page 8, lines 21-23. Therefore, light, upon entering surface 516, tends to bend towards the axis of symmetry 520 as it would entering a convex lens. This light then reflects off one of the planar layers 506 and, upon exiting the surface 516, bends towards the axis of symmetry 520 again. Hence, the non-concave reflector effectively focuses light by bending it towards the axis of symmetry of the optical cavity in a manner similar to a plano-convex lens in combination with a reflector.

In view of the illustrative figures and specification language, it is apparent that there is sufficient disclosure so as to enable a person skilled in the art. Applicant, therefore, respectfully requests that the rejection to claims 1-16 and 18 be withdrawn.

2. Rejections under 35 U.S.C. § 112, Second Paragraph

a) Statement of the Rejection

Claims 1-16 have been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicant regards as the invention. In particular, the phrase “that reflects off the reflector back upon itself” from claim 1 is described as “confusing and indefinite.” Also, from claim 9, the phrase “first non-concave means for reflecting ... including means for focusing the light reflects

off the first non-concave means” is described as “confusing and indefinite” for being unclear as to “the relationship between the means for focusing and the reflection of the light from the non-concave means.” Additionally, claims 10 and 12 are described as being unclear about the relationship between the outer layer and the means for focusing. Finally, claims 21 and 22 have been rejected for omitting steps between “reflecting” and “focusing.” In response to these rejections, Applicant has amended some of the claims as follows to provide an accurate and precise description of Applicant’s originally disclosed invention.

b) Discussion of the Rejection

The language of claim 1 has been modified to more clearly indicate the direction of light in the optical cavity. Likewise, the language of claim 9 has been modified to more clearly indicate the relationship between the means for focusing and the reflection of the light from the non-concave means.

With regards to claims 10 and 12, Applicant believes that these claims are acceptable under 35 U.S.C. § 112, paragraph two, in light of the previous arguments. As described above, a means for reflecting can be combined with a means for focusing, as demonstrated in figure 4. The outer layers of material described in claims 10 and 12 are two such means for focusing light as a part of a non-concave means for reflecting light.

With regards to claims 21 and 22, Applicant believes that these claims are similarly acceptable and that the step between “reflecting” the light and “focusing” the light is logical based on the above referenced specification language.

B. Claim Rejections - 35 U.S.C. § 102

1. Claims 1-2, 9-10, 17, and 21

a) Statement of the Rejection

Claims 1-2, 9-10, 17, and 21 have been rejected as being anticipated by Scifres, et al. ("Scifres," U.S. Pat. No. 4,815,084). According to the Office Action, Scifres discloses Applicant's invention as recited in the claims including an optical cavity bounded by a non-concave reflector that focuses light. Applicant respectfully traverses this rejection.

b) The Scifres Reference

Scifres is directed at edge-emitting semiconductor lasers as shown in the figures and described in the specification as follows, "The lasers comprise a plurality of contiguous semiconductor layers forming a semiconductor body, portions of at least one of the layers forming an active region for lightwave generation. Such layers also form *the light guiding region, wherein light propagates via total internal reflection.*" (Scifres, Col. 3, Lines 7-12) (emphasis added)

c) Discussion of the Rejection

It is axiomatic that "[a]nticipation requires the disclosure in a single prior art reference of *each element* of the claim under consideration." W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 1554, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1983) (emphasis added). Therefore, every claimed feature of the claimed invention must be represented in the applied reference to constitute a proper rejection under 35 U.S.C. § 102(b).

Applicant has amended the claims to more clearly identify that the invention relates to *vertical* cavity surface emitting lasers and similar optical filters. Scifres, however, does not disclose such devices. As noted above, Scifres instead uses edge-emitting lasers, wherein "light

propagates via total internal reflection” and therefore travels within a layer towards the side edges of the device. The light then escapes along an edge of the device, as is evidenced by light beam 84 in Fig. 1.

Applicant’s claims now emphasize that the claimed invention is directed at a “vertical cavity surface emitting laser” and a “vertical semiconductor optical filter”. In that Scifres only discloses edge-emitting lasers, Applicant respectfully submits that Scifres cannot anticipate Applicant’s claims and therefore requests that the rejection be withdrawn.

2. Claim 22

a) Statement of the Rejection

Claim 22 has been rejected as being anticipated by the patent issued to Colbourne (“Colbourne,” U.S. Pat. No. 5,666,225). According to the Office Action, Colbourne teaches a method for filtering light between a pair of reflectors using a gradient index lens.

b) The Colbourne Reference

Colbourne discloses a Fabry-Perot etalon, or bandpass, filter, which incorporates an optical cavity with reflectors at each end wherein light is focused with a graded index lens.

c) Discussion of the Rejection

Applicant has amended claim 22 to clarify that the invention applies to vertical cavity surface emitting lasers. Colbourne does not make mention of a laser as an element of the invention. Rather, Colbourne discloses only optical filters that do not generate light. For at least this reason, Applicant submits that Colbourne does not anticipate claim 22 and respectfully requests that the rejection of claim 22 be withdrawn.

B. Claim Rejections - 35 U.S.C. § 103

1. Claims 3 and 11

a) Statement of the Rejection

Claims 3 and 11 have been rejected as being obvious to one skilled in the art under Scifres. Although Scifres does not teach a *semispherical* outer layer, the Office Action asserts that it would be obvious to make the convex surface into such a shape. Applicant respectfully traverses this rejection.

b) Discussion of the Rejection

As identified above in reference to claims 1 and 9, Scifres fails to teach either a vertical cavity surface emitting laser or a vertical semiconductor optical filter. Instead, Scifres is directed only to edge-emitting semiconductor lasers. Applicant respectfully submits that claims 3 and 11, which depend from independent claims 1 and 9, respectively, are allowable over the Scifres for at least the same reason that the independent claims are allowable over Scifres. Furthermore, it would not be obvious to apply Scifres to a vertical cavity surface emitting laser or a vertical semiconductor optical filter, because it would require a complete redesign of the optical cavity to account for light running perpendicular through the semiconductor layers as opposed to running parallel within the layers. Applicant therefore respectfully requests that the rejections of claims 3 and 11 be withdrawn.

2. Claims 4-5 and 12-13

a) Statement of the Rejection

Claims 4-5 and 12-13 have been rejected as being obvious under Scifres in view of Colbourne. The Office Action states that, although the use of gradient index lenses are not disclosed directly by Scifres, the use of such lenses is commonly known in the art, as

demonstrated by Colbourne. Applicant respectfully traverses this rejection.

b) Discussion of the Rejection

As identified above in reference to independent claims 1 and 9, Scifres does not teach either a vertical cavity surface emitting laser or a vertical semiconductor optical filter as defined in Applicant's claims. In that Colbourne does not remedy this deficiency, Applicant respectfully submits that claims 4-5 and 12-13, which depend from independent claims 1 and 9, respectively, are allowable over the Scifres/Colbourne combination for at least the same reason that the independent claims are allowable over Scifres.

Furthermore, it has been well established that teachings of references can be combined only if there is some actual suggestion or incentive to do so. ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). In this case, the Office Action does not identify any motivation or suggestion in the prior art to modify the Scifres device to comprise a gradient index lens, as demonstrated in Colbourne. For at least these reasons, Applicant respectfully requests that the rejection of claims 4-5 and 12-13 be withdrawn.

3. Claims 6-8 and 14-16

a) Statement of the Rejection

Claims 6-8 and 14-16 have been rejected as being obvious under Scifres in view of Scobey ("Scobey," U.S. Pat. No. 5,786,915). According to the Office Action, these claims are obvious because the use of such a reflector is well known in the art, as is evidenced in Scobey. Applicant respectfully traverses this rejection.

b) Discussion of the Rejection

As identified above in reference to independent claims 1 and 9, Scifres does not teach either a vertical cavity surface emitting laser or a vertical semiconductor optical filter as defined in Applicant's claims. In that Scobey also does not render obvious the vertically oriented optical cavities claimed here, Applicant respectfully submits that claims 6-8 and 14-16, which depend from independent claims 1 and 9, are allowable over the Scifres/Scobey combination for at least the same reason that the independent claims are allowable over Scifres.

Furthermore, as with the previous rejection, the Office Action does not provide any motivation or suggestion to combine the teachings of Scifres and Scobey. ACS Hospital Systems, 732 F.2d at 1577. For at least these reasons, Applicant respectfully requests that the rejection of claims 6-8 and 14-16 be withdrawn.

4. Claims 19 and 20

a) Statement of the Rejection

Claims 19-20 have been rejected as being obvious under Scifres in view of Colbourne. The Office Action states that, although the use of gradient index lenses are not disclosed directly by Scifres, the use of such lenses is commonly known in the art, as demonstrated by Colbourne. Applicant respectfully traverses this rejection.

b) Discussion of the Rejection

As identified above in reference to independent claims 1 and 9, Scifres does not teach either a vertical cavity surface emitting laser or a vertical semiconductor optical filter as defined in Applicant's claims. In that Colbourne does not remedy this deficiency, Applicant respectfully submits that claims 19 and 20 are allowable over the Scifres/Colbourne combination for at least the same reason that claims 1 and 9 are allowable over Scifres.

Furthermore, as before, the Office Action does not provide any motivation or suggestion to combine the teachings of Scifres and Colbourne. Id. For at least these reasons, Applicant respectfully requests that the rejection of claims 19 and 20 be withdrawn.

C. Cancelled Claims

As identified above, claims 17-18 have been canceled from the application through this response without prejudice, waiver, or disclaimer. Applicant reserves the right to present these canceled claims, or variants thereof, in continuing applications to be filed subsequently.

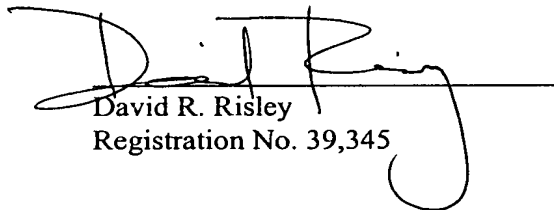
D. Newly Added Claims

As identified above, claims 23-41 have been added into the application through this response. Applicant respectfully submits that these new claims describe inventions that are novel and unobvious in view of the prior art of record and, therefore, respectfully requests that these claims be held to be allowable.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicant respectfully submits that all objections and/or rejections have been traversed, rendered moot, and/or accommodated, and that claims 1-16, and 19-41 are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephonic conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

Respectfully submitted,



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ANNOTATED VERSION OF MODIFIED CLAIMS
TO SHOW CHANGES MADE

The following claims have been amended by deleting the bracketed (“[]”) portions and adding the underlined (“ ”) portions.

1. (Once amended) [An optical cavity] A vertical cavity surface emitting laser, comprising:
an optical cavity including:
a first [a] non-concave reflector positioned at a first end of the optical cavity, the reflector being configured to focus light that reflects off the reflector back [upon itself] in an opposite direction to avoid diffraction losses from the optical cavity; and
a second non-concave reflector positioned at a second end of the optical cavity that receives and reflects light reflected from the first non-concave reflector.
2. (Once amended) The laser [optical cavity] of claim 1, wherein the first non-concave reflector includes an outer layer of material that has a thickness that varies as a function of radial distance out from an axial center of the outer layer.
3. (Once amended) The laser [optical cavity] of claim 2, wherein the outer layer includes a substantially convex, semispherical outer surface and a substantially planar inner surface.
4. (Once amended) The laser [optical cavity] of claim 1, wherein the first non-concave reflector includes an outer layer of material that has an index of refraction ~~that~~ varies as a function of radial distance out from an axial center of the outer layer.

5. (Once amended) The laser [optical cavity] of claim 4, wherein the outer layer is substantially planar.

6. (Once amended) The laser [optical cavity] of claim 1, wherein the reflectors include a plurality of material layers oriented in a stacked arrangement.

7. (Once amended) The laser [optical cavity] of claim 6, wherein the material layers have different indices of refraction than adjacent material layers.

8. (Once amended) The laser [optical cavity] of claim 6, wherein the material layers have quarter wave optical thicknesses.

9. (Once amended) [An optical cavity] A vertical cavity surface emitting laser, comprising:

an optical cavity including:

first non-concave means for reflecting light at a first end of the optical cavity, the first non-concave means for reflecting light including means for focusing the light [that reflects off of the first non-concave means for reflecting light] entering and exiting the first non-concave means so that diffraction losses from the optical cavity are reduced; and

second non-concave means for reflecting light at a second end of the optical cavity that receives and reflects light reflected from the first non-concave means for reflecting light.

10. (Once amended) The laser [optical cavity] of claim 9, wherein the first non-concave means for reflecting light includes an outer layer of material that has a thickness that varies as a function of radial distance out from an axial center of the outer layer.

11. (Once amended) The laser [optical cavity] of claim 10, wherein the outer layer includes a substantially convex, semispherical outer surface and a substantially planar inner surface.

12. (Once amended) The laser [optical cavity] of claim 9, wherein the first non-concave means for reflecting light includes an outer layer of material that has an index of refraction that varies as a function of radial distance out from an axial center of the outer layer.

13. (Once amended) The laser [optical cavity] of claim 12, wherein the outer layer is substantially planar.

14. (Once amended) The laser [optical cavity] of claim 9, wherein the means for reflecting light at the first and second ends of the cavity include a plurality of material layers oriented in a stacked arrangement.

15. (Once amended) The laser [optical cavity] of claim 14, wherein the material layers have different indices of refraction than adjacent material layers.

16. (Once amended) The laser [optical cavity] of claim 14, wherein the material layers have quarter wave optical thicknesses.

19. (Once amended) [An optical device] A vertical cavity surface emitting laser, comprising:

an optical cavity including:

a first reflector positioned at a first end of the optical cavity, the first reflector including a layer of material that has an index of refraction that varies as a function of radial distance out from an axial center of the layer such that the first reflector is configured to focus light that reflects off [of] the first reflector to avoid diffraction losses from the optical cavity; and

a second reflector positioned at a second end of the optical cavity that receives and reflects light reflected from the first reflector.

20. (Once amended) The laser [optical cavity] of claim [4] 20, wherein the outer layer is substantially planar.

21. (Once amended) A method for manipulating light in [an optical device] a vertical cavity surface emitting laser, comprising:

reflecting light between two reflectors of an optical cavity of the [optical device] laser;
and

focusing the light with a layer of material having a thickness that varies as a function of radial distance out from an axial center of the layer to reduce diffraction losses.

22. (Once amended) A method for manipulating light in [an optical device] a vertical cavity surface emitting laser, comprising:

reflecting light between two reflectors of an optical cavity of the [optical device] laser;

and

focusing the light with a layer of material having an index of refraction that varies as a function of radial distance out from an axial center of the layer to reduce diffraction losses.